Generation of orthogonal polarization singularity lattice

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Abstract: Interference of three vector beams with desired states of polarization is known to produce C-point lattice embedded with V-points. In this article we present a method for realizing an orthogonal lattice embedded with polarization singularity such as C-points and V-points. Experimentally this lattice can be realized by using a phase only spatial light modulator (SLM) in the optical 4f Fourier filter setup, where the SLM is displayed with numerically calculated appropriate phase mask. These polarization structures may be useful in polarization sensitive microfabrication structures and for polarization based structured illumination.

1. Introduction

In recent times spatially varying polarization distributions embedded with polarization singularities (C-points and V-points) are widely studied among the scientific communities. These are isolated points where some of the parameters related to polarization ellipse is indeterminate [1-3]. C-points and V-points are the singularities in the ellipse and vector fields respectively. Unlike V-points the C-points can occur at any value in the intensity distribution. Further a C-point can be left or right handedness. It is possible to construct an orthogonal C-point for a C-point. Similarly for a V-point it is also possible to construct an orthogonal V-point. Recently it is shown that interference of three or more vector beams can be used to generate array of these singularities [4, 5]. We extend this idea to three vector beam interference to generate two lattice structures which are orthogonal to each other.

2. Three beam Interference

Three vector beams with appropriate states of polarization (radially polarized) are considered to generate polarization singularities lattice structure embedded with C and V-points as shown in Fig. 1a. Here the blue and red colors are used to mark left and right handed polarization distributions. By appropriately tuning the polarizations (azimuthally polarized) of each of the interfering beams one can generate an orthogonal lattice (Fig. 1b) to Fig. 1a. The orthogonal polarization distribution for a left handed (blue) lemon is 180 rotated right handed (red) lemon and vice versa. The corresponding Stokes phase distributions are shown as insets.

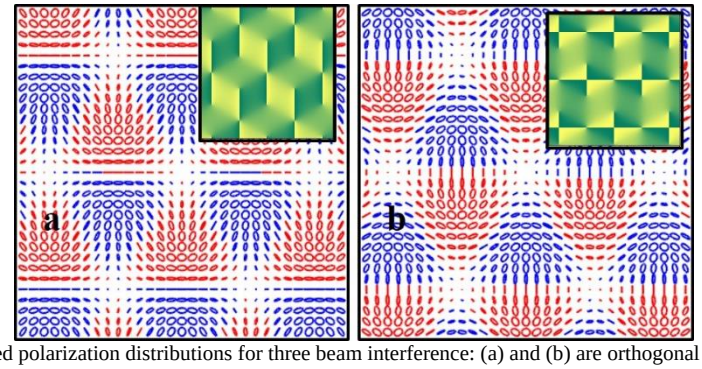

Fig. Simulated polarization distributions for three beam interference: (a) and (b) are orthogonal to each other.

3. Conclusion

We have shown a method for realizing orthogonal polarization singularity lattice structure embedded with C-points and V-points by three vector beam interference. This lattice structure is achieved by appropriately selecting both positions and states of polarization of each of the interfering beams. We expect that this lattice structure may be useful for polarization sensitive microfabrication and structured illumination.

4. References

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